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R-HTA in LMIC's: The Potential of R Shiny User Interfaces to Support Health Economic Decision Making

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23/02/2021

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- 3) Dark Peak Analytics Ltd, Sheffield, UK
- 4) UK Health Security Agency, DHSC.

Before we start ...

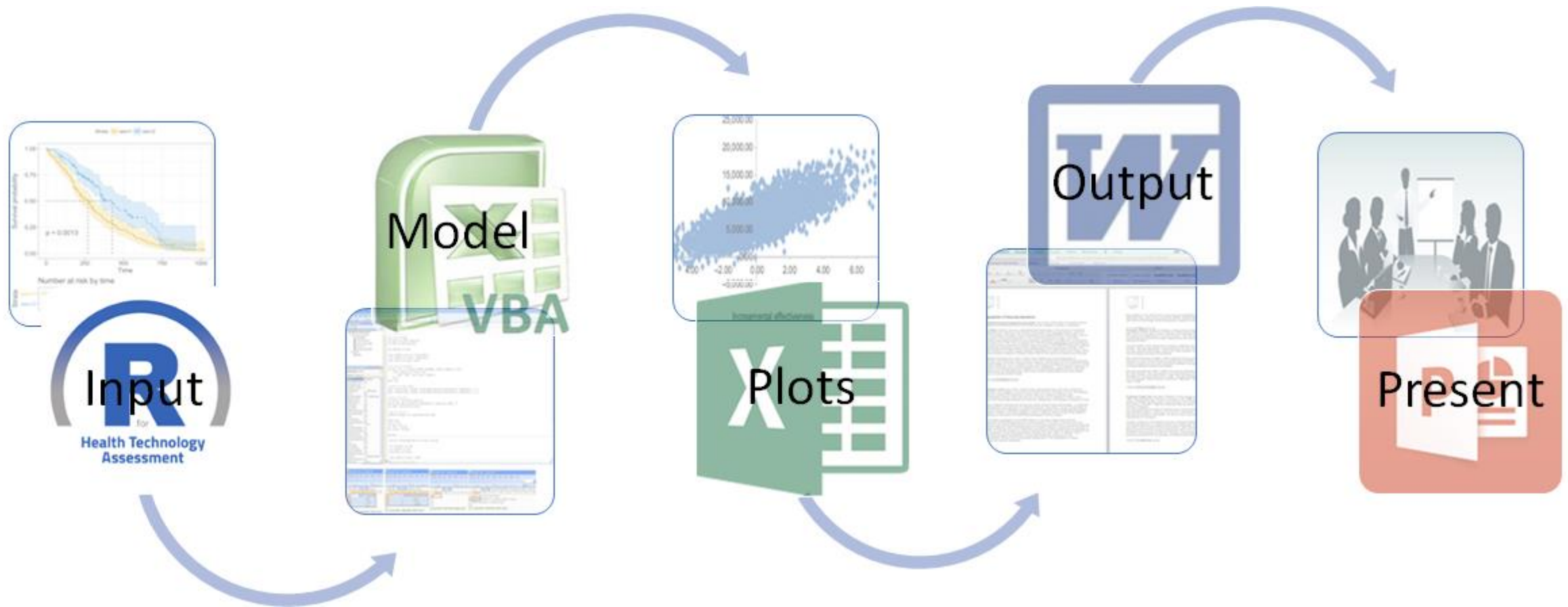
Disclaimer:

The views in this presentation are those of the author and *Dark Peak Analytics*, not of the *University of Sheffield*, *BresMed* or the *UK Health Security Agency*.

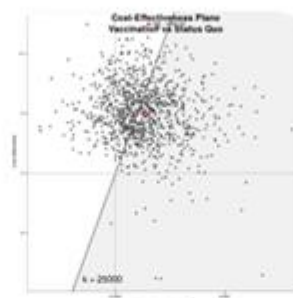
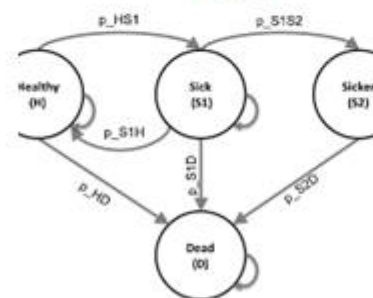
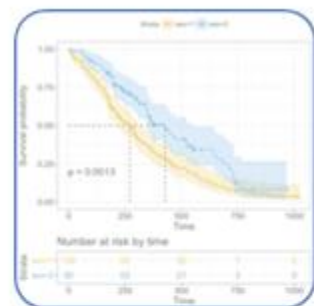
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Current Process



Future Process



VALUING HEALTH TECHNOLOGIES AT NICE:
COMMENDATIONS FOR IMPROVED INCORPORATION
OF TREATMENT VALUE IN HTA

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1. INTRODUCTION:
Recommendations and coverage decisions for medical interventions and services are central activities. Valuing medical technologies to the responsibility of national health-care systems or distribution efficiency under fiscal constraints is a medical specialty. In the UK, the NICE for Health and Clinical Excellence (NICE) is charged with the difficult task of assessing new medical technologies, and making recommendations. This paper NICE coverage that is inconsistent with NICE advice and especially with the absence of assessing the absence of NICE coverage. Nevertheless, the current process of health technology assessment (HTA) has failed to systematically incorporate important sources of value for HTA. In monitoring NICE's current approach to HTA, the UK, the authors adopted a new and novel method relative to what could be achieved if based NICE decisions were to those technologies with greater value.
In recognizing these limitations, NICE commissioned Professor Sir Ian Kennedy to lead a study into a study of valuing interventions aimed at addressing the approach that should be used to ensure that innovation is properly taken into account when establishing the value of technologies, whether particular forms of value be considered more important than others. Innovation in health technologies by default and understanding the relationship is a value. As part of this process, we were asked to present our views on what a 'new' and 'best' could be recommended or accepted within the 'old'.

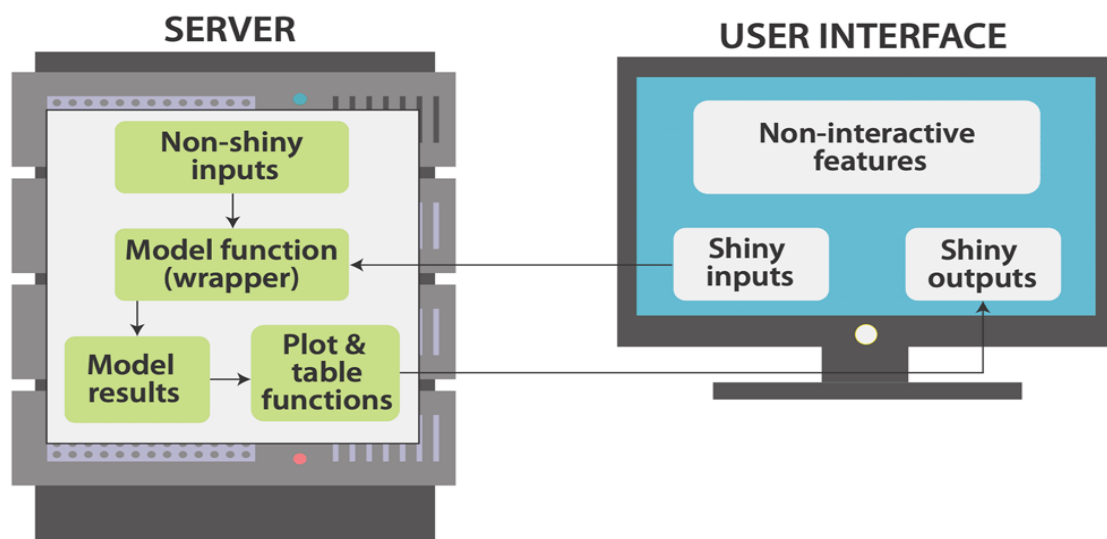


Future Process



Open-source tutorial

ShinyApp function



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METHOD ARTICLE



REVISED Making health economic models Shiny: A tutorial [version 2; peer review: 2 approved]

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Abstract

Health economic evaluation models have traditionally been built in Microsoft Excel, but more sophisticated tools are increasingly being used as model complexity and computational requirements increase. Of all the programming languages, R is most popular amongst health economists because it has a plethora of user created packages and is highly flexible. However, even with an integrated development environment such as R Studio, R lacks a simple point and click user interface and therefore requires some programming ability. This might make the switch from Microsoft Excel to R seem daunting, and it might make it difficult to directly communicate results with decisions makers and other stakeholders.

The R package Shiny has the potential to resolve this limitation. It allows programmers to embed health economic models developed in R into interactive web browser based user interfaces. Users can specify their own assumptions about model parameters and run different scenario analyses, which, in the case of regular a Markov model, can be computed within seconds. This paper provides a tutorial on how to wrap a health economic model built in R into a Shiny application. We use a four-state Markov model developed by the Decision Analysis in R for Technologies in Health (DARTH) group as a case-study to demonstrate main principles and basic functionality.

A more extensive tutorial, all code, and data are provided in a [GitHub repository](#).

Keywords

Health Economics, R, RShiny, Decision Science

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Open-source tutorial

Sick Sicker Model in Shiny

Treatment Cost

200

PSA runs

1000

initial age

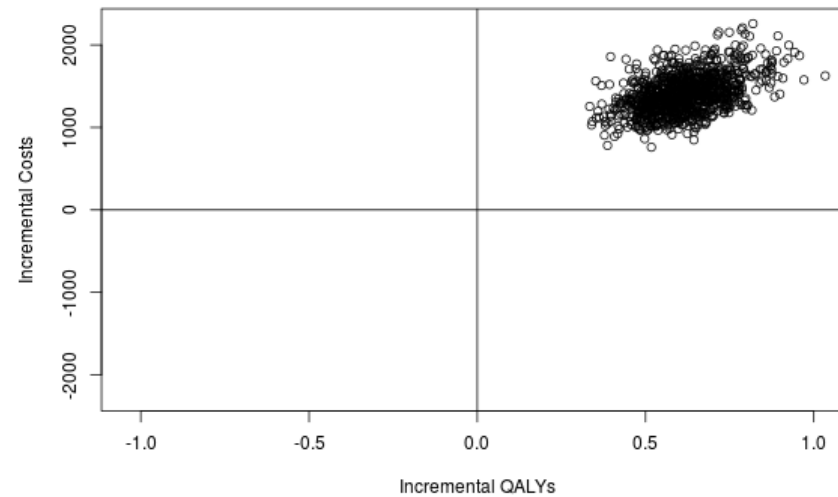
10 25 80

Run / update model

Results Table

Option	QALYs	Costs	Inc.QALYs	Inc.Costs	ICER
Treatment	18.59	100441.67	0.62	1406.24	2324.54
No Treatment	17.97	99035.43	NA	NA	NA

Cost-effectiveness Plane



https://robertasmith.shinyapps.io/sick_sicker

Open-source tutorial

Inputs → Function → Outputs

Parameters		
c_s1	cost1	3
c_s2	cost2	5
c_H	cost3	6
dr	Dis_rate	0.035
n_sim	No. psa	1000

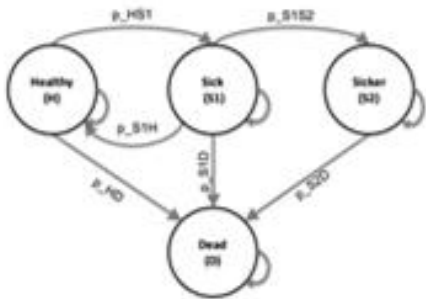
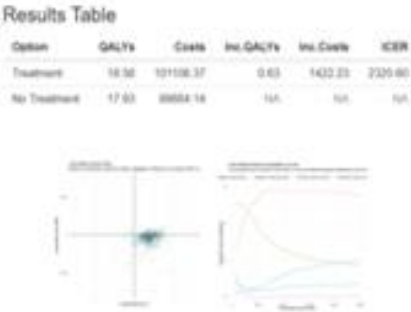


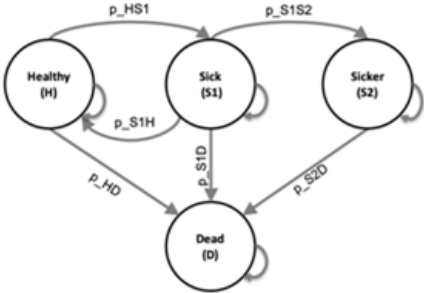
Figure 1. State-transition diagram of the time-independent Sick-Sicker cohort state-transition model with the name of the health states and possible transitions with their corresponding transition probabilities.



Open-source tutorial

Inputs → Function → Outputs

Parameters		
c_s1	cost1	3
c_s2	cost2	5
c_H	cost3	6
dr	Dis_rate	0.035
n_sim	No. psa	1000



Results Table					
Option	QALYs	Costs	Inc.QALYs	Inc.Costs	ICER
Treatment	18.56	101106.37	0.63	1422.23	2320.60
No Treatment	17.93	99084.14	NA	NA	NA

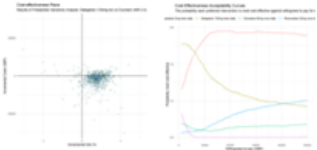


Figure 1: State-transition diagram of the time-independent Sick-Sicker cohort state-transition model with the name of the health states and possible transitions with their corresponding transition probabilities.



Treatment Cost
200

PSA runs
1000

Initial age
55

UI code

```
ui <- fluidPage (    # creates empty page

# title of app
titlePanel("Sick Sicker Model in Shiny"),

# layout is a sidebar-layout
sidebarLayout(

# open sidebar panel

    < SIDEBAR PANEL CODE >

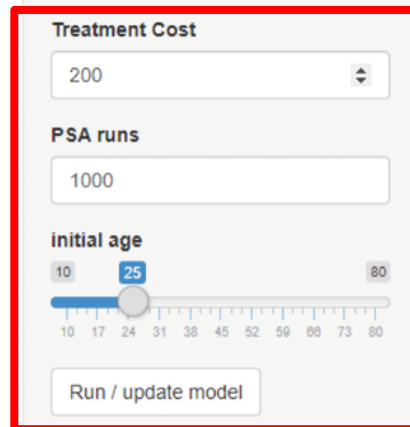
# open main panel

    < MAIN PANEL CODE >

    ) # close sidebarlayout

) # close UI fluidpage
```

Sick Sicker Model in Shiny



Treatment Cost

200

PSA runs

1000

initial age

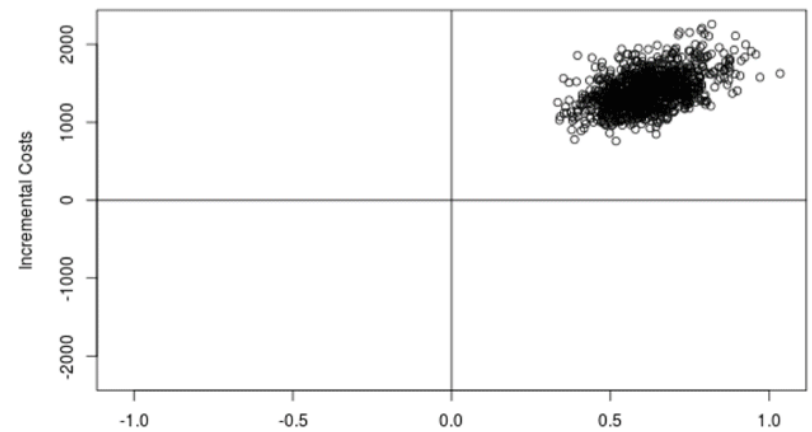
10 25 80

Run / update model

Results Table

Option	QALYs	Costs	Inc.QALYs	Inc.Costs	ICER
Treatment	18.59	100441.67	0.62	1406.24	2324.54
No Treatment	17.97	99035.43	NA	NA	NA

Cost-effectiveness Plane



Sidebar Panel Code

```
sidebarPanel( # open sidebar panel

  numericInput(inputId = "SI_c_Trtr",
    label = "Treatment Cost",
    value = 200,
    min = 0,
    max = 400),

  numericInput(inputId = "SI_n_sim",
    label = "PSA runs",
    value = 1000,
    min = 0,
    max = 400),

  sliderInput(inputId = "SI_n_age_init",
    label = "Initial Age",
    value = 25,
    min = 10,
    max = 80),

  # action button runs model when pressed
  actionButton(inputId = "run_model",
    label = "Run model")

) # close sidebarPanel
```

The image shows a sidebar panel with a light gray background. It contains three input controls and one button. The first control is labeled 'Treatment Cost' in purple, with a text input field showing the value '200'. The second control is labeled 'PSA runs' in purple, with a text input field showing the value '1000'. The third control is labeled 'initial age' in purple, with a slider input. The slider has a blue track and a gray knob positioned at 25. The slider's range is from 10 to 80, with major tick marks at 10, 17, 24, 31, 38, 45, 52, 59, 66, 73, and 80. Above the slider, the values 10, 25, and 80 are displayed in small boxes. Below the slider is a button labeled 'Run / update model'.

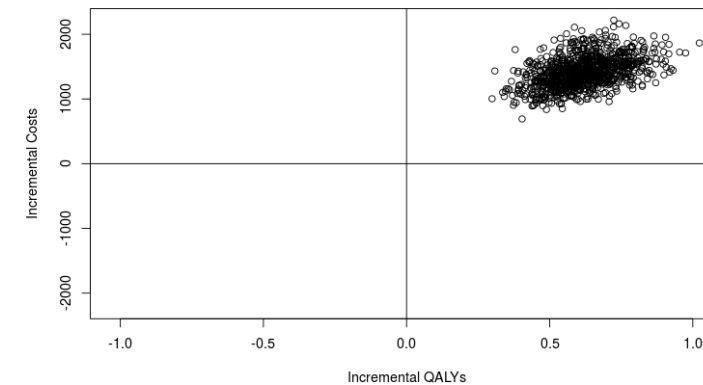
Main Panel Code

```
mainPanel(  
  # heading (results table)  
  h3("Results Table"),  
  
  # tableOutput id = icer_table, from server  
  tableOutput(outputId = "SO_icer_table"),  
  
  # heading (Cost effectiveness plane)  
  h3("Cost-effectiveness Plane"),  
  
  # plotOutput id = SO_CE_plane, from server  
  plotOutput(outputId = "SO_CE_plane")  
  
  ) # close mainpanel
```

Results Table

Option	QALYs	Costs	Inc.QALYs	Inc.Costs	ICER
Treatment	18.61	101016.42	0.62	1412.82	2335.56
No Treatment	17.99	99603.60	NA	NA	NA

Cost-effectiveness Plane



Server Code

```
server <- function(input, output){

  observeEvent(input$run_model, # WHEN ACTION BUTTON PRESSED
    ignoreNULL = F, {

# Run model function with Shiny inputs
df_model_res = f_wrapper(c_Trt = input$SI_c_Trt,
                        n_age_init = input$SI_n_age_init,
                        n_sim = input$SI_n_sim)

#— CREATE COST EFFECTIVENESS TABLE —#
# renderTable continuously updates table
output$SO_icer_table <- renderTable({ < ICER TABLE FUNCTION > }) # table plot end.

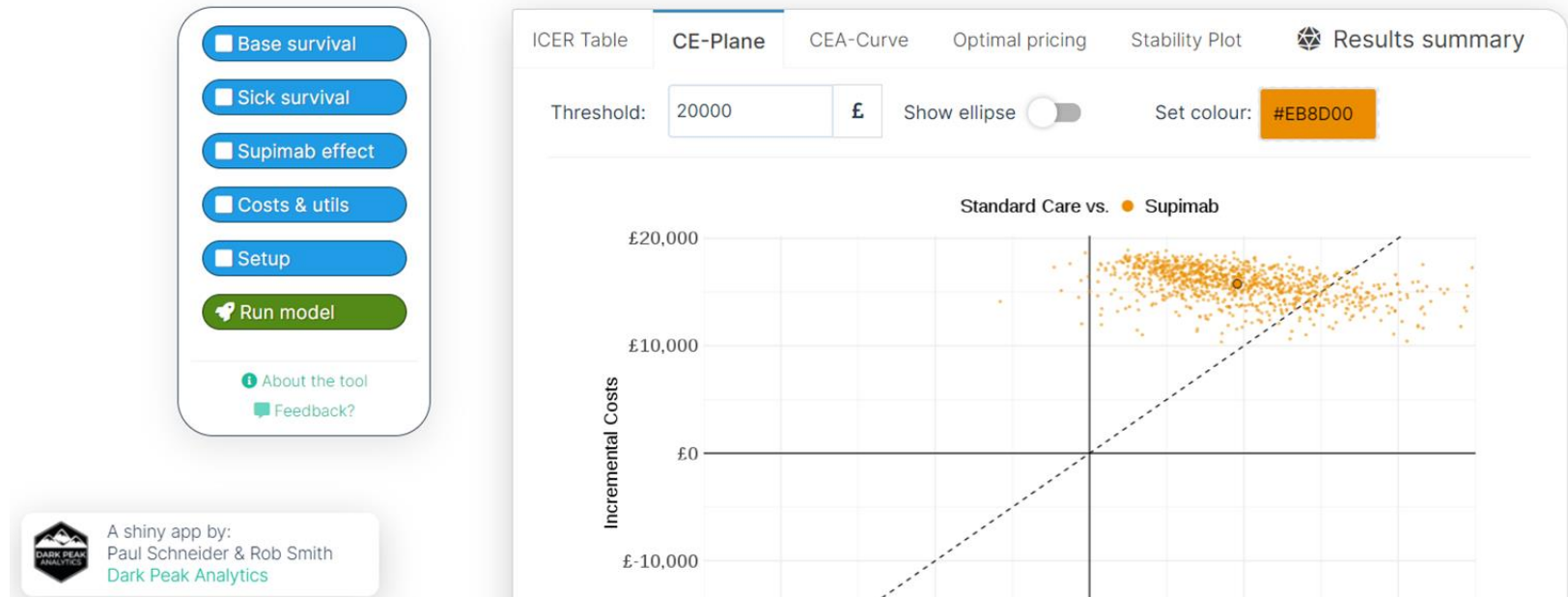
#— CREATE COST EFFECTIVENESS PLANE —#
# render plot repeatedly updates.
output$SO_CE_plane <- renderPlot({ < CE PLANE FUNCTION > }) # renderplot end

}) # Observe event end

} # Server end
```

More Sophisticated App

A lean shiny app for a simple markov model - [beta 1.0](#)



Open-source materials

Simple materials:

App: https://robertasmith.shinyapps.io/sick_sicker/
Paper: <https://wellcomeopenresearch.org/articles/5-69>
Code: https://github.com/RobertASmith/paper_makeHEshiny
Tutorial: https://r-hta.org/tutorial/markov_models_shiny/

More advanced materials:

App: <https://darkpeakanalytics.shinyapps.io/sadm-mk2/>
Code: <https://github.com/bitowaqr/sadm-mk2>
Package: <https://github.com/RobertASmith/darkpeak>



R-HTA in LMIC's